COURSE DESCRIPTION CARD - SYLLABUS

Course name
Industrial automation [S1ZiIP2>AuP]

Course

Field of study
Management and Production Engineering

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
45

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

Lecturers

Prerequisites

Basic knowledge of mathematics, including set theory, complex numbers, differential equations, Boolean algebra, and other areas of study related to the field of study. Systematic theoretical knowledge within the scope of the study program. Basic skills in operating with complex and logical variables, as well as sets, solving simple differential equations, and describing basic physical phenomena in mechanics. The ability to use literature (acquiring knowledge from indicated sources) and the Internet. Physics in the area of matter structure and electrical phenomena, as well as electrical engineering. Understanding the need for lifelong learning. Understanding the broader social impacts of engineering activities. Understanding the need for teamwork.

Course objective

Acquisition of knowledge on the operating principles of electrical machines and devices, skills in analyzing and solving equations describing simple electrical circuits. Familiarization with the construction, operation, and characteristics of electronic components, as well as learning the basics of designing and commissioning simple electronic circuits. Introduction to embedded systems. Learning about automation components and systems, including fundamental concepts and the static and dynamic properties of linear and nonlinear control elements and systems, controller selection, and automation of complex systems. Acquisition of knowledge on the construction, operating principles, and parameters of industrial automation components, including measurement, logical, regulatory, and actuator elements, as well as basic knowledge of the construction and operating principles of PLC controllers and embedded controllers with selected programming languages.

Course-related learning outcomes

Knowledge:
The student has knowledge in the fields of electrical engineering, electronics, and automation, encompassing topics used for the design and analysis of electrical control systems for machines.
The student knows basic passive electronic components and their properties.
The student knows the fundamental laws used in electrical engineering and the principles of solving linear direct and alternating current circuits.
The student knows the structure of the p-n junction, the principle of operation of diodes, diode rectifiers, and semiconductor switching elements.
The student has knowledge of the structure, operation, and parameters of bipolar and unipolar transistors, as well as the power supply, types, and operating configurations of transistors.
The student has knowledge of integrated circuits, including operational amplifiers.
The student knows what an automation system is, understands the difference between open-loop and closed-loop systems, and knows the basic concepts and objectives of automation.
The student knows what binary functions, combinational circuits, and sequential circuits are.
The student knows the methods of implementing binary functions on contact elements, logic gates, and fluid switching systems.
The student knows what a transfer function is and knows the responses of basic linear automation elements to step inputs.
The student knows what frequency characteristics are and how to determine them for automation elements. They know the basic concepts and methods for stability analysis.
The student knows what classical controllers are and their construction, and understands stability issues.
The student knows the structure of complex automation systems and generally understands production control.
The student has knowledge of embedded control systems and PLCs, and knows the principles of their programming.
The student knows the principles of operation of basic industrial sensors and transducers. The student knows the principles of operation of various drives used in industry.

Skills:
The student has the ability to self-educate, including for the purpose of improving professional competencies.
The student can perform measurements of basic electrical quantities, analyze physical phenomena, and solve direct and alternating current circuits based on fundamental laws.
The student can apply simple power regulators in direct and alternating current circuits.
The student can describe basic linear automation elements, including transfer functions, characteristics, and examples.
The student can implement a given combinational and sequential binary function using contact, contactless, and fluid circuits in a hazard-free manner.
The student can determine the frequency characteristics of basic elements and assess the stability of a simple automation system.
The student can determine the equivalent transfer function of any combination of basic automation elements.
The student can describe the operation of a PID controller and determine the stability of a simple automation system.
The student can define the tasks of a complex automation and production control system.

The student can analyze linear direct and alternating current circuits.
The student can analyze a simple electronic circuit.
The student can select a sensor or transducer considering the prevailing conditions.
The student can determine the required control system for a device, considering its intended purpose.
The student can select the type of drive for a specific task.

Social competences:
The student is aware of the social role of a technical university graduate, particularly understanding the need to formulate and communicate to the public, especially through mass media, information and opinions regarding technical achievements and other aspects of engineering activities; the student makes efforts to convey such information and opinions in a universally understandable way.
The student understands the need to keep up with available solutions in the fields of automation and control systems.
The student is aware of the role of electrical engineering and electronics in industry and their significance for society and the environment.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Laboratory: Laboratory credit is granted based on preparation for classes and reports on completed activities. Credit is awarded based on the correct completion of exercises and a report on each laboratory exercise according to the instructions of the laboratory instructor. Short entry tests, either oral or quizzes, are conducted before each exercise. To pass the laboratory component, all exercises must be completed (positive grade for the preliminary knowledge test and the report).
Lecture: The assessment is in the form of a test, which can also be electronic, covering the topics discussed in the lectures, consisting of a minimum of 20 questions. The test includes single or multiple-choice questions with at least 4 possible answers for each question. The passing threshold is 50%. Assignment of grades to percentage ranges of results: <90-100> very good; <80-90) good plus; <70-80) good; <60-70) satisfactory plus; <50-60) satisfactory; <0-50) unsatisfactory.

Programme content

The course covers the fundamentals of electrical engineering, control systems, and digital techniques, with particular emphasis on practical and theoretical issues related to electronics and industrial automation. Topics include the effects of electric current on the human body, the structure and operating principles of semiconductors, and the basics of digital technology, including logic gates and microcontrollers. Additionally, the course focuses on the analysis of linear direct and alternating current circuits, methods for solving electrical circuits, and PLC control systems. The aim of the laboratory classes is to develop practical skills, such as analyzing control system parameters, measuring in direct and alternating current circuits, and simulating and designing simple electronic circuits. Special emphasis is placed on regulating control system parameters and the application of selected sensors and industrial drives.

Course topics

TLecture:
- Effects of electric current on the human body,
- Electric current,
- Electrical measurements,
- Direct current (DC) and alternating current (AC) electrical circuits,
- Methods of solving electrical circuits,
- Electrical resonance,
- Laplace transform,
- Linear and nonlinear control systems,
- Control systems and controller selection,
- Structure and electrical properties of atoms, conductors, insulators, and semiconductors; passive components used in electronic circuits; electronics assembly,
- Semiconductors, p-n junction; rectifier circuits,
- Bipolar transistors: structure, parameters, operation,
- JFET and MOSFET transistors, thyristor, triac,

- Integrated circuits, operational amplifiers, and others,
- Basics of digital technology: gates and microprocessors,
- Selected sensors and transducers,
- PLC and embedded control systems,
- Selected industrial drives.

Laboratory:
- Switching circuits based on contact elements,
- Combinational circuits implemented on industrial controllers,
- Two-position controller,
- Analysis of basic control elements parameters,
- PI controller in DC motor speed control system,
- Basic measurements in DC circuits,
- Basic measurements in AC circuits,
- Simulation of simple electrical circuits,
- Induction motor in single-phase network,
- Power regulators,
- DC power supply

Teaching methods

Lecture: Blackboard lecture supported by a multimedia presentation containing the discussed program content.
Laboratory: Practical exercises, teamwork.

Bibliography

Basic:
1. Opydo W., Elektrotechnika i elektronika dla studentów wydziałów nieelektrycznych, WPP, Poznań, 2012 r.
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3. Żelazny M., Podstawy automatyki, PWN, 1976
4. Horla D., Podstawy automatyki - ćwiczenia rachunkowe, WPP, 2008
5. Traczyk W., Układy cyfrowe automatyki, WNT, 1974
6. Horowitz P., Hill W. „Sztuka elektroniki”.

Additional:
1. Orlik W., Egzamin kwalifikacyjny elektryka w pytaniach i odpowiedziach
2. Miedziński B., Elektrotechnika. Podstawy i instalacje elektryczne, Wydawnictwo Naukowe PWN, Warszawa 1997 r.
3. Mikulski A., Elementy przekaźnikowych urządzeń automatyki, WKŁ, 1970
4. Kindler H., Buchta H., Wilfert H., Zadania z techniki regulacji automatycznej, WNT, 1971
5. Urbaniak A., Podstawy automatyki, WPP, 2001
6. Kostro J., Elementy, urządzenia i układy automatyzacji, WSiP, 1993
7. Kosmol J., Automatyzacja obrabiarek i obróbki skrawaniem, WNT, 1995
8. Pietrzyk W. „Laboratorium z elektrotechniki i elektroniki”

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	77	3,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	48	2,00